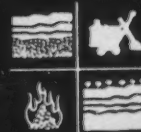


The Coal Situation



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OUTLOOK FOR THE U.S. DOMESTIC METALLURGICAL COAL MARKET

It has been 50 years since the United States consumed less metallurgical coal than it did in 1982, a grim result of the 1980-1982 recession and its impact on the nation's steel industry. Since reaching its low point in 1982, steel production, with the recovery in the economy, has been on the increase. This, in turn, has produced increased carbonization of coal in the nation's coke batteries. The purpose of this issue of *The Coal Situation* is to examine the long-term outlook for the U.S. domestic metallurgical coal market.

HISTORY OF THE DOMESTIC METALLURGICAL COAL MARKET

In 1982, 37.1 million metric tons (tonnes) of bituminous coal were carbonized at U.S. domestic coke plants, a decline of 33 percent from the 55.3 million tonnes carbonized in 1981. Not since the Great Depression of the 1930s has the nation consumed less metallurgical coal than it did in 1982. While the depth of the recession and its impact on the nation's steel industry in large part explains the dramatic fall-off in last year's metallurgical coal demand, the nation's use of metallurgical coal has been on a downward trend for the last 10 years.

Table 1 shows the volume and compound average annual growth rates for U.S. domestic consumption, exports, and production of metallurgical coal for the period 1963 through 1982. As shown in the bottom half of the table, domestic consumption of metallurgical coal grew at a compound rate of 1.9 percent per year over the decade 1963 through 1973, a significant recovery over the previous decade. Beginning in 1973, however, domestic use of metallurgical coal has declined, with the rate of decline accelerating between 1979 and 1982. While the 1979-82 results are distorted by the severity of recession, the acceleration in the decline in metallurgical coal usage was nevertheless present.

TABLE 1
U.S. METALLURGICAL COAL MARKETS 1963-1982
(Million Metric Tons)

	Domestic Consumption	Exports	Production (E)
1963	70.5	40.7 (E)	111.2
1973	84.9	38.7	123.6
1979	69.9	46.0	118.8
1982	37.1	59.0	94.6
Compound Annual Growth Rates — % Year			
1963-75	1.9	-0.5	1.1
1973-79	-3.2	2.9	-0.7
1979-82	-19.0	8.6	-7.3

(E) Estimates

Sources: National Coal Association, *Coal Data*, Various Issues,
Dept. of Energy, *Quarterly Coal Report*.

It is by no means coincidental that the sharp departures in the rates of growth shown for the 1973-79 and 1979-82 periods coincide with the oil price shocks of 1973-74 and 1979-80. This reflects the negative impact these two events have had on the rate of growth in the nation's economy and, therefore, steel demands. The effect was compounded, however, by the rapid increase in energy prices, which served to accelerate the rate of decline in the nation's steel intensity. Steel intensity, the ratio of apparent steel consumption to Gross National Product (GNP), is a standard measure of the structural relationship between steel demand and economic activity.

Shown in Figure 1 is the history of U.S. steel intensity for the period 1967 through 1982. As shown, the steel intensity of the U.S. economy has fallen since the later 1960s. The decline, however, was very modest until the Arab oil embargo, with a dramatic downward shift beginning in 1975 and again in 1982. These changes are directly related to structural changes produced by higher energy prices, such as the downsizing of (and material substitution in) the American automobile, the redesign and miniaturization of home appliances, the displacement of steel by aluminum for beverage cans, etc. While these structural changes were affecting the nation's demand for steel, the manner in which demand was satisfied was also changing. The first of these changes was the growing importance of cheaper steel imports, as shown in Table 2.

FIGURE 1

U.S. STEEL INTENSITY

(Metric Ton of Raw Steel Equivalent per 1000 1972 \$ of GNP)

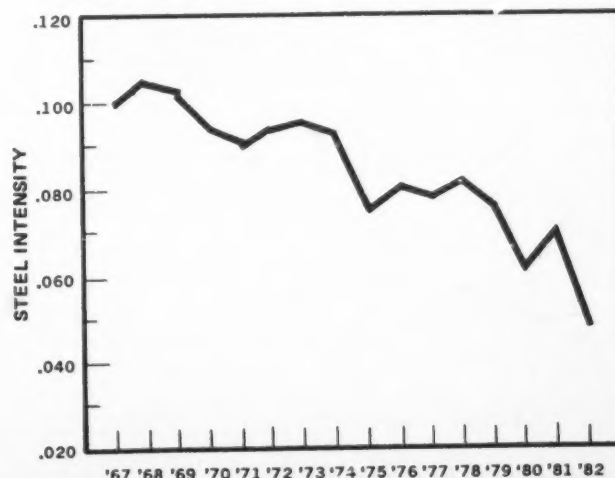


TABLE 2
U.S. STEEL SUPPLY AND IMPORTS
(Million Metric Tons)

	Available Steel Supply*	U.S. Steel Imports	Imports as a Percent of Supply
1963	71.5	4.9	6.0
1973	111.2	13.7	12.3
1979	104.3	15.9	15.4
1982	69.3	15.1	21.8

* Shipments + Imports - Exports

Source: American Iron and Steel Institute

In addition to the displacement of a portion of the market by imports, structural changes within the domestic industry affected the role of the integrated steel mills and their use of the blast furnace in providing feedstock to the steel furnaces. Table 3 shows the U.S. raw steel and pig iron production for the period 1963 through 1982. As shown in the last column, the proportion of U.S. raw steel production satisfied by integrated producer blast furnaces has declined. This decline represents the increased reliance on the electric furnace and steel scrap to produce steel. The growing importance of the electric furnace reflects its cost advantage over the integrated producer because of the significant differences in manning levels of the production process and the cost of scrap. These differences are reflected in the fact that while integrated producers were registering massive losses, many electric furnace mills were operating profitably.

TABLE 3
U.S. RAW STEEL AND PIG IRON PRODUCTION
(Million Metric Tons)

	Raw Steel Production	Pig Iron Production	Pig Iron as a Percent of Raw Steel
1963	99.2	65.2	65.7
1973	136.8	91.8	67.1
1979	123.3	78.9	64.0
1982	67.7	39.3	58.1

Source: American Iron and Steel Institute

While the importance of the integrated mill has been waning, changes in the operation of blast furnaces also have been affecting metallurgical coal demands. Shown in Table 4 is the U.S. blast furnace average fuel consumption expressed in tonnes of coke and coke equivalents per tonne of pig iron produced. As shown in the first column, the use of coke per tonne of pig iron has been steadily declining over the timeframe. In fact, coke use has declined steadily due to improvements in blast furnace technology for many more years than those shown here. In part, the decline in coke use was the result of the increased use of supplemental fuel, such as oil and natural

TABLE 4
U.S. BLAST-FURNACE FUEL CONSUMPTION
PER UNIT OF OUTPUT
(Metric Tons of Coke Equivalent
Per Metric Ton of Pig Iron)

	Coke	Supplemental Fuels	Total Fuel Rate
1963	.676	.017	.693
1973	.600	.040	.640
1979	.575	.053	.628
1982	.538	.035	.573
Compound Average Percent Change			
1963-73	-1.2	8.9	-0.8
1973-79	-0.7	4.8	-0.3
1979-82	-2.2	-12.9	-3.0

Source: American Iron and Steel Institute.

gas, as illustrated in the middle column. Overall, however, technological improvements have reduced the quantity of energy needed to fuel the blast furnace.

The rapid price increases in supplemental fuels, most notably oil and natural gas, coupled with the competition from imports and mini-mills, have led the integrated producer to concentrate on reducing costs. This has meant the closing of old, inefficient operations and a greater emphasis on efficiency at the remaining plants. The net result has been an acceleration in energy efficiency as shown for the period 1979 through 1982. This has meant an acceleration in the fall-off in the use of both coke and supplemental fuels.

The combined effect of the changes outlined above was the drop in domestic metallurgical coal requirements since 1973, culminating in the 33 percent decline in 1982. The quantity of coal received at U.S. coke plants by volatile content is outlined in Table 5.

TABLE 5
COAL RECEIPTS BY U.S. COKE PLANTS
BY VOLATILE CONTENT
(Million Metric Tons)

	High Over 31%	Medium 22%-31%	Low 14%-22%	Total
1973	58.5	9.2	16.1	83.8
1979	45.3	9.3	15.8	70.4
1982	22.1	7.0	6.5	35.6
Difference 73-82				
Volume	36.4	2.2	9.6	48.2
% of Total	75.5	4.6	19.9	100.0

Source: Dept. of Energy

FACTORS INFLUENCING THE OUTLOOK FOR DOMESTIC METALLURGICAL COAL CONSUMPTION

It is obvious from the preceding review of recent history that the outlook for domestic metallurgical coal consumption will be dependent upon the direction of U.S. economic growth rates, steel intensity, steel imports, electric furnace production, and changes in blast furnace technology. There are two additional factors, however, which gain in importance over time. These are the continuous casting of steel and domestic coke oven capacity. The first influences the quantity of steel needed to be produced in order to satisfy apparent consumption, while the second influences the ability to domestically produce coke in order to meet future blast furnace requirements.

Economic Growth

The United States is currently in the midst of an economic recovery. While there is still concern surrounding interest rates and their impact on the economy, the general consensus among economists is that the recovery is sustainable. But the anticipated rate of recovery and the sustainable rate of growth over the remainder of the decade are expected to be significantly lower than historical standards.

Steel Intensity

Many of the structural changes which have contributed to the decline in U.S. steel intensity since 1973 are one-time occurrences, the impacts of which will have run their course within the next few years. Therefore, given the prospects of increased levels of investment in the latter half of the decade, a moderate increase in steel intensity can be expected. Such a conclusion, however, would ignore the changing composition of output within a wide range of steel-consuming industries. Generally speaking, these changes will reflect the on-going shift from the manufacturing of heavy industrial products to specialized, or lighter, "high technology" products. This would lead to lower capital investment in the heavy industrial sector, which would diminish steel demand. In addition, an increased emphasis on the production of technologically sophisticated equipment would lead to an increased share of heavy stationary

equipment produced offshore. Therefore, the continuation of a general downward trend in the U.S. steel intensity over the remainder of the decade is expected.

Steel Imports

While trade agreements can serve to protect local production in the short term, ultimately, the level of U.S. steel imports is a function of the competitive position of U.S. producers. After all, trade controls lead to higher prices. While higher prices protect domestic producers, the final products produced become less competitive, which leads to decreased exports and increased imports of finished and semi-finished goods.

The United States steel industry has taken positive steps in becoming more competitive with alternative sources of steel. Chase believes that the emphasis on cost savings and increased efficiency is permanently embedded in the industry. As a result, steel imports will not be expanding as rapidly as they did in the past.

Mini-Mill and Electric Furnace Production

The growth in the role of the electric furnace, in particular the non-integrated mini-mill, is one example of the steel industry's emphasis on cost savings. Because of lower manning levels (estimated to be 2.0 man-hours per ton of steel shipped for a mini-mill versus 7.5 man-hours for an integrated mill for bar products) and other efficiencies, steel can be produced at a significant cost advantage over the integrated process. While this advantage is sensitive to the price of scrap, labor costs and other efficiencies support the continued strong growth in the role of the electric furnace and the mini-mill in meeting domestic steel needs. An important change in this area will be the movement towards higher quality steels. In the past, the major growth in mini-mill electric melt has been for low-grade steel. In the future, growth will be in the areas of high-quality steel, supported by improvements in the segregation of scrap by quality.

Continuous Casting

Once again the continuous casting of steel reflects an area of improvement in the cost of production. As for its impact on metallurgical coal consumption, lower scrap rates means fewer tonnes of raw steel need to be produced in order to satisfy apparent consumption.

In 1982, 29 percent (21 million tonnes) of the U.S. raw steel production was continuously cast. In contrast, Japan continuously cast 79 percent of its 1982 output. Throughout the remainder of the decade and into the next, continuous casting will play an increasing role in U.S. steel production.

Blast Furnace Technology

As was illustrated in Table 5, blast furnace coke rates and total fuel rates have been on a steady decline for many years. This decline has accelerated more recently as the steel industry turned to its most efficient furnaces and emphasized cost savings. While energy efficiency has been greatly improved, significant improvement can still be made through changes in the technology and operation of existing facilities. Among the improvements that will be occurring are the reduction of the silica content of the charged ore, improvements in refractory lining (allowing thinner walls and increased operating temperatures), moisture injection, direct injection of lower grade coal, and increased operating pressures.

Coke Oven Capacity

The nation's effective coke oven capacity has been steadily declining for a number of years. This has been a function of the financial health of the steel industry and environmental issues surrounding the manufacturing of coke.

Shown in Table 6 is the status of U.S. coke oven capacity as of December 31, 1982. As a reference point, at year-end 1981, the U.S. had 9,742 operational coke ovens with an annual capacity of 45.3 million tonnes, and an additional 558 ovens with a combined capacity of 3.7 million tonnes were under construction or being rebuilt. The most significant points to

be drawn from the table are the average age of existing facilities and the very low level of oven rebuilds and new construction. Given the present state of the U.S. steel industry, it is likely that there will be a continuing weakness in industry investment in coke oven capacity. Thus, further deterioration in productive capacity can be expected.

TABLE 6
U.S. COKE OVEN STATUS
AS OF DECEMBER 31, 1982

	Number	Average Age	Annual Coking Capacity (Million Metric Tons)
Operational Ovens	9,079	19.1	43.9
Ovens Being Rebuilt or Repaired	237	18.5	1.5
Ovens Under Construction	92	—	0.7
Total	9,408	19.1	46.1

Source: Dept. of Energy, Quarterly Coal Report

FORECAST OF U.S. METALLURGICAL COAL CONSUMPTION

The projections of U.S. steel and pig iron production are shown in Table 7. Low, medium and high forecasts are provided in order to recognize uncertainty surrounding U.S. economic growth rates, steel intensity, and imports. The main point to be drawn from the forecasts is that U.S. steel and pig iron production are not expected to recover to levels registered before the second oil price shock of 1979-80. It must also be pointed out that the forecasts for the period 1985-90 are based on a trend analysis of U.S. economic growth rates. That is, no recognition is given to the cyclical peaks and valleys of the economy. Thus, the implied smooth progression in growth masks the cyclicity that can be expected between now and the end of the decade.

TABLE 7
FORECAST OF U.S. STEEL AND PIG IRON PRODUCTION
(Million Metric Tons)

Actual	Raw Steel Production			Pig Iron Production		
1979	123			79		
1980	102			62		
1981	109			67		
1982	67			39		
1983 (Estimated)	75			45		
Forecast	Low	Med.	High	Low	Med.	High
1984	86	95	102	51	56	60
1985	90	100	108	51	59	64
1990	95	107	118	51	59	68

Based on the expectations for continued declines in coke rates, the forecasted pig iron production shown in Table 7 translates into a range in blast furnace coke requirements shown in Table 8. Historically, an additional 13 to 15 percent of coke and coke breeze is consumed in applications other than the blast furnace both inside and outside of the steel industry. Assuming this historical relationship is maintained and that there is no major change in the amount of coke obtained from a tonne of coal, the resulting quantity of metallurgical coal that would be needed to be carbonized at U.S. coke plants is shown in the last column of Table 8.

As is readily apparent from the table, the assumptions incorporated in this analysis produce a forecast of domestic metallurgical coal requirements which do not recover to the previous levels of consumption experienced as late as 1981. In fact, as shown for both the Low and Medium cases, demand, after recovering in 1984 and 1985, is expected to trail-off by 1990.

TABLE 8
FORECAST OF U.S. COKE AND
METALLURGICAL COAL CONSUMPTION
(Million Metric Tons)

<u>Actual</u>	<u>Blast Furnace Coke Consumption</u>			<u>Metallurgical Coal Carbonized</u>		
1979	45.4			69.9		
1980	35.5			60.3		
1981	36.7			55.3		
1982	21.2			37.1		
1983 (Estimated)	23.4			38.6		
<u>Forecast</u>	<u>Low</u>	<u>Med.</u>	<u>High</u>	<u>Low</u>	<u>Med.</u>	<u>High</u>
1984	27	29	31	45	48	52
1985	26	31	33	43	52	55
1990	25	29	34	42	48	56

As an additional note, the quantity of coke required by the blast furnace, adjusted for coke use in other areas, compared to the existing coke oven capacity that was provided in Table 6, implies a growing concern over future coke oven availabilities. Accounting for the age of the existing facilities, the effective producing capacity of existing ovens is approximately 32 to 35 million tonnes. Adjusting this figure for the use of coke and coke breeze in other applications leaves only 27 to 30 million tonnes available for the blast furnace, which when compared to the figures in Table 8 indicates shortages at existing capacity which are sure to grow in the future.

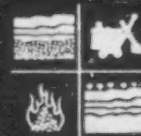
Thus, the metallurgical coal requirements shown in the table are subject to downward revisions owing to coke imports, a situation previously experienced during the period 1975 through 1979. At the peak in 1978, the U.S. steel industry imported 5.2 million tonnes of coke, principally from West Germany. West Germany presently has a coke inventory of approximately 11.8 million tonnes.

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CRITICAL ISSUES IN RECENT COAL PROJECT FINANCINGS

There have been no less than ten major, limited-recourse coal project financings in the last eighteen months. They have ranged in size from \$100 million to \$1 billion for the development of a coal property and its associated infrastructure. Most of these projects were geared to international trade.

Why has there been so much activity? There are two primary reasons. The first is the large number of contracts which were signed as a result of OPEC oil shocks. High projections were made for increased coal consumption, particularly in world trade. Second is the high cost of coal development in the 1980s compared with a typical company's corporate borrowing capacity.

As a result of recession and structural changes in world economies and energy usage, the coal market has entered a period of oversupply resulting in falling prices and a slow-down of major new coal mine developments. This is not to say that there are no current coal transactions. On the contrary, there are numerous examples, but these are now more typically leverages and acquisitions of producing properties.

When the market does strengthen and interest in developing new coal properties returns, the projects which will be able to move quickly enough to secure a share of the market will be those which:

- a. are low enough on the cost curve vis-a-vis the competition and
- b. are sufficiently developed through feasibility studies and permitting requirements and
- c. have already studied financing alternatives.

Limited-recourse, project financing will be among the alternatives considered. In examining this alternative, sponsors must recognize that the project financing of the future will be influenced by the lenders' past experiences. Therefore, it is appropriate to review the nature of past developments to see which aspects created problems during financing and how they were mitigated. Those sponsors who benefit from the experience of the past will assure a more timely financing of their project when the time comes for development.

What is Project Financing?

In a very simplified form, project financing involves a lender looking primarily, if not solely, to an operation's cash flow as the source of debt service. There will be various amounts of contractual support from various parties depending on the particular situation. It is true that this is more complex and time-consuming than regular corporate finance, but it can provide greater benefits to a company's overall ability to

raise debt. Most extractive natural resource projects lend themselves to project financing due to their stand-alone nature. Reserves, production, transportation and marketing form a self-contained operation providing isolated cash flow.

The ability to isolate cash flow in and of itself does not necessarily mean that all natural resource projects can be easily project financed. Rather, the ability to isolate cash flow and mitigate the primary components of risk associated with maintaining cash flow dictates the ability and ease of project financing. The primary risks associated with a project differ by the type of resource being developed. This can be seen in a comparison of differences between petroleum and coal limited recourse financing.

Unlike petroleum, there is no joy in drilling an exploration hole and hitting coal. To the contrary, one is surprised when one does *not* hit coal. That's not to say that coal reserves are a liability; but certainly with discovery the problems have just begun. The values applied to coal reserves in the ground are, therefore, minimal. We will discuss how this affects asset values in coal project financings later on. The coal industry *does* have very high risk areas in production and marketing. This is in contrast to the petroleum industry, where the high risk is during exploration and development (finding and defining reserves).

The structure of a coal project financing is therefore quite different from that of a petroleum financing. One must be satisfied not only with reserve estimates but also with production cost estimates. Operating costs are high and generally result in slim margins. In addition, unlike petroleum sales, contract terminology and market position are critical. Furthermore, since coal is not homogeneous, quality variation risks must be considered. Of all these considerations, the most important distinction between oil and coal is that the marketing of oil is much less of an issue than it is for coal. Although some credit can be given to coal's spot market, projects must have a large proportion of production covered by offtake contracts. The requirement of offtake contracts for an oil development is rare.

Analysis of Risks for Project Financing

The standard list of risks which must be addressed in a project financing are:

- 1) reserve risk
- 2) completion risk
- 3) production risk
- 4) market risk
- 5) political risk
- 6) foreign exchange risk

Rather than simply define these risk areas, it is more helpful to present examples of actual problems encountered in recent coal financings. Ideally, a company will be able to obtain project debt in a more timely manner and at a lower cost by giving early thought to these issues.

Reserve Risk

The key question here is, "Are the coal reserves of sufficient quantity and quality to provide for the projected volumes of production over the expected life of the project?" For a coal mine this has historically been a low risk area due to large reserves and long mine lives. These lives are often about thirty years. Since the term of most project loans from commercial banks are in the neighborhood of ten years, there is usually more than sufficient reserve base to provide comfort to the lenders. A general rule of thumb is to have at least one third of the reserve remaining at the scheduled date of loan maturity.

Coal quality, however, often presents a problem in that it may vary from seam to seam and/or from year to year within the project life. The risk of delivered coal quality not meeting sales contract specifications must be mitigated through proper exploration techniques. The banks look to adequate core-hole drilling to provide sufficient quality analysis. Problems with the reserve test usually occur due to quality, not quantity.

For instance, a recent coal project ran into delays because management had only focused on the early years of production. A simple division of total reserves by annual production showed more than the necessary coverage. However, little consideration had been given to those years beyond the loan term (let's say years 11-15). There was insufficient drilling in the area and the trend showed increasing sulfur. The initial solution proposed by the company was to increase underground production into reserves of proven quality. This was not satisfactory, as it would have overworked the fine coal circuit in the preparation plant. The ultimate solution was to add a "reserve test clause" which compared remaining surface recoverable reserves at acceptable sulfur levels to the remaining term of the loan. This obviously assumed the eventual purchase of additional reserves if subsequent drilling did not prove up reserve quality. This solution was necessary in order to expedite loan closing.

Completion Risk

This risk can vary considerably depending on the location of the project and the amount of infrastructure required. The period of highest risk for a bank is that time when a large percentage of the funds have been extended yet the project is still not capable of producing and shipping coal. The questions that must be addressed in assessing completion include: Is the technology for getting the coal out of the ground proven? Can the mine and the necessary infrastructure be constructed within the capital budget? Can the mine be completed on time and will it be capable of producing and delivering projected volumes within given costs over a reasonable demonstration period?

An issue under this category, specific to coal projects, is the importance of transportation. Transportation cost, usually rail, is often key to a project's competitiveness. Furthermore, a proposed rail and port link are often the only transportation method viable. Economics do not permit haulage via truck or plane, as do some high-value-to-weight-ratio minerals.

Terminology in the coal sales agreement can be used to reduce this risk. For example, does a delay result in termination of the contract or can coal be temporarily supplied from an alternate source?

Most projects have been structured with the parent providing a completion guarantee. While some banks have been willing to take the non-completion risk, it is important to note that this will be done at a premium interest rate which must be weighed versus the company's other commitments. For instance, in a recent financing, the sponsor found that it had already had to make certain completion guarantees to the local government which was constructing the associated rail

and port facilities. For this reason, the decision was made not to accept the banks' offers of completion risk financing and to borrow at lower cost against their own completion guarantee.

Production Risk

After completion, will the mine be able to produce projected volumes within given cost parameters over the term of the financing? This is similar to the risk that a coal purchaser takes when signing a sales contract on an unproven coal mine. One must look to the past experience of the coal mine operator, the detail and accuracy of feasibility studies, and to similar mines, if any, in the same region. The following examples illustrate some production risk difficulties encountered during recent project financings.

In one case, a surface mine was planning on going underground using longwall mining technology in order to maintain historic production levels in the face of rapidly increasing stripping ratios. There was little local underground experience with which to support the longwall productivity assumptions and no real data on roof conditions. The solution was to delay the commitment to longwall until additional information was available and to base the loan on cash flow from the existing surface production.

A second example involved a very remote mine. The operators had selected a hydraulic shovel for removal of a very stiff clay overburden which had caused conventional shovels problems in the past. They had also selected what amounted to the largest trucks every used in the country! Needless to say, the banks were leery of taking all the production risk. The solution in this case was a sharing of risk with the equipment manufacturers. Shovel diggability factors were contracted for and, more importantly, the truck manufacturer guaranteed 85% mechanical availability through a maintenance program. The operator found that this fixed cost, although higher than what his own maintenance costs might be, enabled him to arrange more aggressive financing terms which were more than compensatory.

Market Risk

The market risk is associated with the ability of the project to maintain a sales volume and price structure necessary to maintain cash flow. With the normal oversupply condition of coal, banks have generally been hesitant to take any part of this risk. Rather, banks like to see a very strong contractual relationship between supplier and consumer both through the sales agreement and through a long-term commitment. Equity injection on the part of the consumer will always be helpful.

It is important to note that a producer's strategy during coal contract negotiations should be different if he is planning on utilizing a high debt-to-equity ratio. For instance, there are certainly times when a higher coal sales price can be obtained for spot and short-term contracts. However, there is an initial percentage of any project's production which must be under long-term sales agreements in order to facilitate financing, particularly for a new resource development. Similarly, it will be easier to obtain debt if a sizeable portion of sales is to end users as opposed to brokers. It is also preferable to have sales with more than one user. This is, in part, a result of recent overcommitments by countries, notably Taiwan and Japan.

Coal contracts should be viewed as a basis for a relationship. A so-called "air tight" agreement which is not equitable to both parties has less financing appeal than one which assures fair negotiations. A recent case involved a utility which had little experience with coal boilers. The coal being purchased through a long-term sales agreement was within contract quality specifications but was causing boiler problems. The solution of allowing the supplier to source blending coal from elsewhere is an example of the use of the coal contract on which to base negotiations.

It is important for coal mine developers to take a practical, long-term view of demand. A marriage of the production and

marketing risks highlights the need for a mine plan to be flexible. What is the relationship between fixed and variable costs? Will the mine be able to lower production in order to match demand without suffering drastically higher operating costs? A case presented to financing institutions must show the project's ability to service debt during low-demand periods. Mine plan options might include the selection of two smaller draglines rather than one large one, a percentage of contract production, or the inclusion of room and pillar sections in an otherwise all longwall operation.

Political Risk

If the mine is in a foreign country, will there be restrictions that negatively affect cash flow? What is the possibility of expropriation? Political risks are not confined to projects outside the United States. What if a new U.S. environmental regulation required a costly new waste disposal system? What if there's a new safety regulation that requires a 20% increase in the workforce? Again, the coal sales agreement is looked to for governmental regulation pass through provisions.

There is no more timely example of this than the pending acid rain legislation in the United States. A large non-recourse production payment loan was recently made to a mid-west coal producer. With a term of eight years, it was clear that some form of regulation would affect the coal market prior to loan maturity. How was this handled? Each mine involved was analyzed as to its competitive ranking based on both operating costs and sulfur content. The producer had a strong history of working with its customers and had a good understanding of each utility's policy towards scrubbers. Once several demand scenarios were projected, it became apparent that the company was well-positioned to continue to generate adequate cash flow. The loan was made with an appropriate structure to allow the company to alter coal sourcing between mines, as may be required by future legislation.

Foreign Exchange Risk

This applies to international projects. In what currencies will the project revenues, costs and debt be denominated? Will their rates remain stable? The currency risk may be assumed by the lenders, but a well-conceived financing plan can mitigate any potential problem from the beginning. The classic plan will denominate the loans in the currency of the project's revenues.

Foreign exchange rates will also have an effect on a project's competitiveness in the export market. The strong United States dollar is an important reason for the difficulty in marketing coal overseas. In a country such as Australia, where 50% of coal production is exported, the advantage of timely currency devaluations does not go unnoticed.

Recognition of Asset Value

The discussion so far has focused on critical aspects of recent coal project financings which are key to determining whether or not a project has sufficient debt service capacity. The lending institutions must be comfortable with all risk assumptions used to project annual cash flows. There is a secondary aspect which must be studied: the asset value. It is important to note that project financings will *not* be done based solely on asset value. The project must be deemed to be profitable in its own right. The asset value is determined only so the banks will know their position under a "what if" case. Typically, all equipment, surface facilities and coal rights will be assigned to the lenders as security. It is therefore useful to briefly describe the logic and methodology behind this appraisal.

It must be understood that banks are looking to the "worst case" where the coal venture has not been successful. This clearly reduces the resale value of the assets. The property is typically divided into three categories. These are the mobile assets (primarily equipment), the fixed facilities and the coal reserves.

Equipment that can be easily transported is relatively easy to sell and as such can be valued quite highly. This is especially true for the smaller, more standard pieces which can be used in other industries but are more difficult for large, specialized equipment such as draglines. On the other hand, draglines hold their value well. Similarly, deep mining equipment has a more limited resale market.

The asset values for *fixed* facilities such as offices, warehouses, preparation plants, silos and rail spurs must also be determined based on a "worst case" situation. What is their value assuming the project has not been successful? The failure may well mean there has been a general downturn in the coal industry. Their value is really only to the same coal reserve and as such requires a purchaser willing to continue the operation. Given the assumption of an unprofitable mine, this will typically be below book value. It is important to remember that these are not numbers on which a loan will be based, but rather a lender's valuation of his security. The reliability of cash flow is the key element.

The third asset category is coal reserves. What are in-place coal reserves worth? The factors which influence this value are copious. A few of them are:

- Proximity to rail
- Length and nature of existing coal contracts
- Coal quality parameters
- Specifics of geology such as depth, roof conditions and dip for underground mines and ratio for surface mines
- Contiguity of reserves

The variability of these factors leads to a fairly large range of values. A compilation of over fifty recent coal transactions does provide a good basis, however. The price range for virgin reserve purchases tended to be about 15¢/ton to 35¢/ton with an average of 26¢/ton. The standard deviation was 0.06.

It should now be apparent that due to coal's intrinsic low value, reserves are a limited asset in arranging financing. This is especially true when compared with the capital and operating costs needed for extraction and delivery. If one assumes capital of \$75 per annual ton of production and a mine life of 30 years, then it is clear that reserve asset value will not come close to approaching the necessary investment. In this example, the capital cost would be \$75 times one thirtieth of the coal reserves while the asset value of the reserves would be 26¢/ton. Given these assumptions, the investment would be almost ten times greater than the asset value of the reserves.

Conclusion

Non-recourse and partial-recourse coal project financings have been done and will continue to be done. A company's financing objectives are unique and each transaction must be structured accordingly. It is important to base each decision concerning exploration, mine plan and market partly on the final financing goal, recognizing the associated areas of risk. The earlier this process is brought to bear the better.

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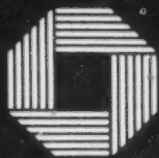
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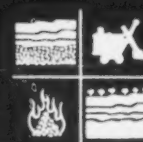
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The Coal Situation



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INTERNATIONAL COAL TRADE — 1984

As expected, the carry-over effect of world recession and accompanying inventory adjustments served to reduce international hard (anthracite and bituminous) coal trade in 1983. Trade in both the metallurgical (coking) and thermal (steaming) coal sectors declined, with the metallurgical coal market most affected. Preliminary statistics indicate that 132.4 million tonnes of metallurgical coal and 127.1 million tonnes of thermal coal were traded in 1983; declines of 5.8 percent and 0.9 percent relative to 1982. While the relative falloff in trade between the two sectors is consistent with the forecast we made last year, metallurgical coal trade attained a level consistent with our high forecast while thermal coal trade fell within our low forecast range. As a result, the total 259.5 million tonnes of coal which entered international trade was 1.5 percent greater than our medium forecast of 255.6 million tonnes issued last year (*The Coal Situation*, Vol. 3, No. 2).

The purpose of this issue of *The Coal Situation* is to review in greater detail the results for international coal trade in 1983 and to provide our outlook for trade flows in 1984.

Review of 1983

As shown in Table 1, a total of 259.5 million tonnes of coal were imported in 1983, a decline of 3.4 percent (9.2 million tonnes) from the revised statistics for 1982. Of this total, metallurgical coal imports declined by 8.1 million tonnes (5.8 percent). This fall-off in metallurgical coal trade was the net result a combined 11.2 million tonnes decline in imports by the European Economic Community (EEC), Other Western Europe, and Japan, which was offset by a combined increase of 3.1 million tonnes by other importing regions.

Overall, thermal coal imports fell by 1.1 million tonnes (−0.9 percent) in 1983. The relatively small decline in thermal

coal trade, however, was the net result of significant decreases in North American and EEC imports, which were offset by increased imports by others. In 1983, the EEC's thermal coal imports declined by 5.4 million tonnes, while North American imports fell by 2.8 million tonnes. This latter figure was the net result of increased imports by the United States and declines in Canadian thermal coal imports.

By sector and in total, the EEC with a fall-off of 11.8 million tonnes was the largest contributor to the overall decline in coal imports for 1983.

Table 2 shows the country detail for the EEC's hard coal imports from third party countries. The statistics shown in the table represent coal imports from nations which are not members of the EEC. The difference between the imports from third party countries (Table 2) and the total imports (Table 1) represent trade between the Community member nations, the vast majority of which is supplied by the United Kingdom and West Germany.

As shown in Table 2, with the exception of a less than 500,000 tonnes increase in the combined imports by Ireland and Greece, the remaining eight members of the Community reduced their imports of coal from third party countries in 1983. The net result was a 11.63 million tonnes decline in the Community's imports from third party countries, a quantity equal to almost 99 percent of the Community's 11.8 million tonnes net decline in total imports. France contributed 3.96 million tonnes to this decline, followed closely by Belgium with a fall-off of 3.67 million tonnes. The other major contributors to the overall reduction in the Community's imports were the Netherlands (−1.45 million tonnes), Italy (−1.23 million tonnes) and Germany (−0.96 million tonnes).

TABLE 1
WORLD HARD COAL IMPORTS 1983 VERSUS 1982
(Million Metric Tons)

	METALLURGICAL COAL			THERMAL COAL			TOTAL		
	1982 (R)	1983 (P)	% Change	1982 (R)	1983 (P)	% Change	1982 (R)	1983 (P)	% Change
North America	4.4	6.3	43.2	13.1	10.3	−21.4	17.5	16.6	− 5.1
Latin America	5.9	6.1	3.4	0.3	0.2	−33.3	6.2	6.3	1.6
EEC	29.2	22.8	−21.9	58.2	52.8	− 9.3	87.4	75.6	−13.5
Other W. Europe	12.9	12.6	− 2.3	10.1	9.6	− 5.1	23.0	22.2	− 3.5
Eastern Europe	10.6	11.0	3.8	19.5	22.8	16.9	30.1	33.8	12.3
Japan	64.0	59.5	− 7.0	14.3	15.2	6.3	78.3	74.7	− 4.6
Other Asia	11.0	11.5	4.5	9.5	12.0	26.3	20.5	23.5	14.6
Others	2.5	2.6	4.0	3.2	4.2	31.3	5.7	6.8	19.3
Total	140.5	132.4	− 5.8	128.2	127.1	− 0.9	268.7	259.5	− 3.4
Seaborne*	119.9	110.1	− 8.2	88.9	88.2	− 0.8	208.8	198.3	− 5.0

* Excluding overland, barge and lake deliveries

(R) Revised

(P) Preliminary

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TABLE 2
EEC HARD COAL IMPORTS FROM THIRD PARTY COUNTRIES
(Million Metric Tons)

	1981	1982	1983	Percent Change	
				1982/81	1983/82
Germany	8.07	8.81	7.85	9.2	-10.9
France	20.13	16.96	13.00	-15.7	-23.3
Italy	16.23	17.43	16.20	7.4	-7.1
Netherlands	5.38	7.80	6.35	45.0	-18.6
Belgium	7.25	8.54	4.87	17.8	-43.0
Luxembourg	0.22	0.23	0.15	4.5	-34.8
United Kingdom	4.13	3.57	3.40	-13.6	-4.8
Ireland	0.76	0.73	0.90	-7.6	23.3
Denmark	8.70	7.58	7.00	-12.9	-7.7
Greece	0.29	0.50	0.80	72.4	60.0
Total	71.19	72.15	60.52	1.3	-16.1

Source: Eurostat, *Coal Monthly Bulletin*

In general, the preliminary statistics for 1983 imports are consistent with the ranges in metallurgical and thermal coal trade that were forecast last year (see *The Coal Situation*, Vol. 3, No. 2). In total, our medium case forecast called for 255.6 million tonnes of imports in 1983 versus the 259.5 million tonnes supported by current statistics. By sector, however, the preliminary results for 1983 metallurgical coal imports are consistent with our high forecast of last year while the thermal coal results are consistent with last year's low forecast case. A comparison of the preliminary estimates of 1983 coal imports versus the most consistent forecast scenario is shown in Table 3.

TABLE 3
FORECASTED VERSUS
PRELIMINARY ESTIMATES OF 1983 COAL IMPORTS
(Million Metric Tons)

	Metallurgical Coal		Thermal Coal		Total	
	High* Forecast	Preliminary Est.	Low* Forecast	Preliminary Est.	Medium* Forecast	Preliminary Est.
North America	4.5	6.3	12.3	10.3	16.7	16.6
Latin America	6.3	6.1	0.5	0.2	6.1	6.3
EEC	22.9	22.8	52.7	52.8	75.0	75.6
Other W. Europe	10.5	12.6	10.5	9.6	21.1	22.2
Eastern Europe	11.2	11.0	23.3	22.8	34.6	33.8
Japan	58.5	59.5	15.2	15.2	72.3	74.7
Others	14.5	14.1	15.3	16.2	29.8	30.3
Total	128.4	132.4	129.8	127.1	255.6	259.5

* Source: *The Coal Situation*, Vol. 3, No. 2

On the exporting side, U.S. exporters, as expected, bore the full brunt of the fall-off in coal imports. The decreased imports by its principal market areas in Western Europe and Japan, coupled with (1) the increased availability and aggressive marketing of Polish coal supplies, (2) increased availability from new mine expansion under long term contractual commitments in Australia, (3) improved labor relations at Australian ports, (4) increased availability of Canadian supplies, (5) continued aggressive marketing by the U.K. National Coal Board, (6) reduced demands for thermal coal imports by Canada, and (7) a strong U.S. dollar, combined to reduce U.S. exports by 27 percent in 1983, falling to a level of 70.4 million metric tonnes.

As shown in Table 4, with the exception of minor declines in exports by South Africa, West Germany, the U.K., and the USSR, the United States was the only exporter experiencing a decline in trade in 1983, all others expanded. In short, the U.S. exporter felt the full effect of the decline in coal imports while simultaneously being displaced by other suppliers. The major winners in the displacement of U.S. supplies were Poland and Australia.

In addition to the remarkable showing for Australian exports and the ability of Poland to recapture market, U.S. exports were also affected by the ability of West Germany and the U.K. to maintain exports levels with their European trading partners.

Outlook for 1984

Following two years of decline, 1984 will be a year of stabilization and recovery in the international market for coal. Recovery, however, will not be experienced universally across all market sectors and importing regions.

In the metallurgical coal sector the increase in the production of iron and steel that was experienced in the latter half of 1983 provides a strong indication that the steel industry has reached the bottom of the recessionary trough. Therefore, expected improvements in economic growth rates in 1984 will bring further improvements in the demand for metallurgical coal. The rate of recovery for the metallurgical coal market, however, will be moderated by the structural changes within the world steel industry which were brought about by the recession of 1981-82. The specific changes that will affect the recovery in the metallurgical coal markets include:

- Rationalization of the steel industry which has meant the permanent closing of older, less energy-efficient blast furnace complexes and the concentration of production at energy and cost-efficient facilities.
- Continued growth in the use of scrap and electric furnaces to produce steel.
- Addition of continuous casting operations at existing steel facilities which generate less scrap and, therefore, more finished steel per ton of raw steel produced.
- Increased imports of unfinished slabs from lower cost, more efficient operations in other countries.
- Completion of the shift to "oil-less" operation of blast furnaces initiated with the rapid increase in oil prices.

Together, these factors serve to alter the historical relationship between coke consumption and steel production. In general, the world steel industry will require less coke, and therefore less metallurgical coal, per unit of raw steel produced. On a regional basis, Western European metallurgical coal demands are most affected by the factors cited above.

Even though the recovery of metallurgical coal trade will not be as strong as it would have been had not the structure of the steel industry changed, there will still be overall growth in the market, in contrast to the two years of decline in 1982 and 1983. As shown in Table 5, metallurgical coal imports are expected to be in a range of 134.4 million tonnes to 142.2 million tonnes.

In the thermal coal sector, the world cement industry has completed or will complete shortly the conversion to coal. Therefore, the rapid acceleration in coal imports by this industry experienced between 1979 and 1982-83 will moderate with imports tracking the growth in cement production.

As for the electric utility component of the thermal coal market, recovery in the demand for electricity experienced in 1983 strengthened by improvements in world economies in 1984 serves to support an overall improvement in the outlook for thermal coal trade. Growth, however, will be concentrated mainly in the Asian markets where the scheduled completion of new coal-fired power plant additions or coal conversions in 1984 and the full-year operation of units added in 1983 will produce increased imports by Taiwan, Korea, Hong Kong and Japan.

In 1983, the EEC experienced a 2.0 percent increase in electricity demands, in contrast to the 0.5 percent decrease experienced in 1982. This positive sign of recovery along with expected economic improvements in 1984 and the scheduled additions of approximately 12.4 gigawatts (GW) of new hard coal-fired power plant additions 1.2 GW of lignite-fired and 3.8 of coal converted facilities would normally support a strong recovery in the EEC thermal coal imports. Recovery, however, will be moderated by the additions of nuclear power plants.

TABLE 4
WORLD HARD COAL EXPORTS 1983 VERSUS 1982
(Million Metric Tons)

	METALLURGICAL COAL			THERMAL COAL			TOTAL		
	1982 (R)	1983 (P)	% Change	1982 (R)	1983 (P)	% Change	1982 (R)	1983 (P)	% Change
United States	58.6	45.3	-22.7	37.8	25.1	-33.6	96.4	70.4	-27.0
Australia	37.1	41.3	11.3	12.7	18.3	44.1	49.8	59.6	19.7
South Africa	3.4	3.2	- 5.9	24.1	23.9	- 0.8	27.5	27.1	- 1.5
Canada	13.9	14.8	6.5	2.1	2.3	9.5	16.0	17.1	6.9
West Germany	6.6	6.4	- 3.0	3.0	3.1	3.3	9.6	9.5	- 1.0
United Kingdom	0.2	0.2	0.0	7.2	6.4	-11.1	7.4	6.6	-10.8
Poland	7.3	8.1	11.0	21.0	27.1	29.0	28.3	35.2	24.4
USSR	10.2	10.0	- 2.0	11.5	11.5	0.0	21.7	21.5	- 0.9
Others	3.2	3.1	- 3.1	8.8	9.4	6.8	12.0	12.5	4.2
Total	140.5	132.4	- 5.8	128.2	127.1	- 0.9	268.7	259.5	- 3.4
Seaborne*	119.9	110.1	- 8.2	88.9	88.2	- 0.8	208.8	198.3	- 5.0

* Excluding overland, barge, and lake deliveries.

(R) Revised

(P) Preliminary

While scheduled new unit additions and conversion will result in increased coal imports by Ireland, Denmark, Italy, Greece, and the Netherlands, the scheduled additions of approximately 6.9 GW, 2.5 GW, and 3.0 GW of nuclear capacity in France, Germany, and the U.K., respectively, will serve to reduce these countries' imports. The magnitude of the impact that these scheduled nuclear additions will have on coal imports will be a function of the strength of economic improvement and accompanying growth in electricity demands and the actual timing of the nuclear additions. For instance, if the nuclear plants were operated for the full year at an average 65

percent capacity factor, 39.3 billion kilowatt hours (KWH) of additional electricity would be generated in France, 14.2 billion KWH in Germany, and 17.1 billion KWH in the U.K. If these quantities were added to actual electricity consumption in 1983, electricity demands would have to increase by 4.0 percent in Germany, almost 15 percent in France, and almost 7 percent in the U.K. in order not to affect the generation of power with other fuels. For comparison purposes, in 1983 electricity demands increased by 2.5 percent in both Germany and France, and 0.9 percent in the U.K.

TABLE 5
WORLD HARD COAL TRADE FORECAST
(Million Metric Tons)

	METALLURGICAL				THERMAL				TOTAL			
	1983 (P)	1984			1983 (P)	1984			1983 (P)	1984		
		Low	Med.	High		Low	Med.	High		Low	Med.	High
Importers												
North America	6.3	6.2	6.4	6.6	10.3	9.1	9.7	10.7	16.6	15.3	16.1	17.3
Latin America	6.1	6.5	7.0	7.7	0.2	0.2	0.2	0.3	6.3	6.7	7.2	8.0
EEC	22.8	23.2	24.7	25.6	52.8	48.2	51.5	54.1	75.6	71.4	76.2	79.7
Other W. Europe	12.6	12.4	13.0	13.6	9.6	10.4	11.2	12.3	23.2	22.8	24.2	25.9
Eastern Europe	11.0	11.0	11.2	11.5	22.8	23.8	24.3	25.0	33.8	34.8	35.5	36.5
Japan	59.5	60.5	61.0	62.0	15.2	15.5	16.0	16.5	74.7	76.0	77.0	78.5
Other Asia	11.5	12.0	12.1	12.3	12.0	14.9	16.0	17.7	23.5	26.9	28.1	30.0
Others	2.6	2.6	2.7	2.9	4.2	4.4	4.6	4.9	5.8	7.0	7.3	7.8
Total	132.4	134.4	138.1	142.2	127.1	126.5	133.5	141.5	259.5	260.9	271.6	283.7
Exporters												
United States	45.3	43.6	45.0	46.8	25.1	21.2	23.3	25.0	70.4	64.8	68.3	71.8
Australia	41.3	42.5	43.5	44.2	18.3	19.4	20.5	21.7	59.6	61.9	64.0	65.9
South Africa	3.2	3.3	3.4	3.6	23.9	24.0	25.5	27.0	27.1	27.3	28.9	30.6
Canada	14.8	16.3	17.0	17.2	2.3	2.7	2.9	3.2	17.1	19.0	19.9	20.4
Poland	8.1	9.2	9.4	10.0	27.1	28.1	29.6	32.1	35.2	37.3	39.0	42.1
USSR	10.0	10.0	10.0	10.0	11.5	11.5	11.8	12.0	21.5	21.5	21.8	22.0
Others	9.7	9.5	9.8	10.4	18.9	19.6	19.9	20.5	28.6	29.1	29.7	30.9
Total	132.4	134.4	138.1	142.2	127.1	126.5	133.5	141.5	259.5	260.9	271.6	283.7
Seaborne	110.1	112.5	115.6	119.3	88.2	89.3	94.0	100.9	198.3	201.8	209.6	220.2

(P) Preliminary

In other areas of the world, the most significant increases in thermal coal imports will be by Israel, Spain, and the U.S. In the case of U.S./Canadian trade, Canadian imports of thermal coal are expected to decline further following the decrease of 3.1 million tonnes seen in 1983. In total, our forecast for the thermal coal markets indicates a range from a low of 126.5 million tonnes to a high of 141.5 million tonnes.

In supplying the international market, the U.S., as in 1983, is expected to be at a disadvantage relative to its competition.

Since the expected growth in imports is concentrated in the Asian market and given the expectation of further expansion of coal sales by Poland in the European market, only under the high demand scenario is the U.S. forecast to expand its exports.

Further complicating the ability of the U.S. to market coal in 1984, is the expiration of the United Mine Workers contract in September. With the availability of supplies from other locations, the consumer may very well avoid the uncertainty

concerning a possible strike by concentrating his purchases from other sources, thus avoiding increased U.S. purchases and stock build-ups in anticipation of a strike. If increased U.S. purchases for strike stockpiling does not materialize in May, June, July and August, and should there be a strike of some duration, actual U.S. exports for the year could quite easily fall below our low forecast. In the thermal coal sector, U.S.

supplies would be replaced by South African exports, while in the metallurgical coal sector the consumer would turn to Australia and Canada for additional supplies.

The forecasted range in world coal imports and exports for 1984 are shown in Table 5.

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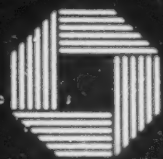
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The Coal Situation



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THE WORLD COAL MARKETS — THE PAST 10 YEARS

Events over the past 10 years have profoundly affected the world coal markets. On the one hand, the oil price shocks of 1973-74 and 1979-80 led to a rapid increase in the use of coal as an alternative and as a replacement for oil products in traditional heat raising applications in the electric power and industrial sectors of the market. The relative attractiveness of coal was further improved by the direct relationship of natural gas prices to oil prices and the diminished attractiveness of nuclear energy. On the other hand, world recession tempered and, in fact, offset some of the gains derived from the dramatic increase in oil and natural gas prices and the nuclear situation. In addition, investments in technological improvements and energy conservation, responding to higher relative energy costs, contributed to a permanent downward shift in the demand for coal.

The purpose of this issue of *The Coal Situation* is to review the performance over the past ten years of the demand for coal in the World Outside of Communist Areas (WOCA). Special attention is paid to identifying both the positive and negative impacts that higher oil prices, recession and structural changes in economies and industry have had on the demand for coal.

Coal Consumption

During the 10 years prior to the first oil price shock (1963-1973), total WOCA coal consumption was declining at a compound average rate of -0.7 percent per year. This movement away from coal was the net result of the falloff in coal consumption by the member nations of the European Economic Community (EEC). This decline in consumption more than offset the growth in coal usage by all other regions of the world. Between 1963 and 1973, EEC coal consumption declined at a compound average rate of -3.9 percent per year. In contrast, U.S. coal consumption, over the same period, grew at 2.7 percent per year, Japan at 2.2 percent per year, Lesser Developed Countries (LDCs) at 2.1 percent per year, and Other Western Europe at 0.3 percent per year.

As shown in Table 1, aided by the first oil price shock, the fortunes of the coal market reversed with total WOCA consumption showing a positive rate of increase of 2.8 percent per year between 1973-79. This rate of growth accelerated in 1980 and 1981, as the market response to the second oil price shock (1979/80) was superimposed on the continuation of the response to the initial oil price increases of 1973-74. Recession, in part caused by the second oil price shock, then took its toll on the market.

As a result of the fall-offs in steel production, general industrial activity, and electricity demands in 1981 and 1982, the growth in WOCA coal consumption fell dramatically, with the declines registered by the developed countries (OECD)

TABLE 1
GROWTH RATES
WOCA COAL CONSUMPTION
(COMPOUND AVERAGE ANNUAL PERCENT)

	1973/79	1979/80	1980/81	1981/82	1982/83
U.S.	3.2	3.3	4.3	-3.5	2.4
Canada	5.1	6.6	2.9	-1.6	6.1
EEC	1.0	0.7	-0.6	-1.9	-2.3
Other W. Europe	5.0	22.6	15.0	8.8	5.0
Total Europe	1.3	2.9	1.2	-0.4	-1.2
Japan	1.2	15.0	10.5	-1.3	-4.0
Australia/N.Z.	3.8	3.7	2.7	1.8	-0.8
Total OECD*	2.2	3.9	3.4	-1.9	0.5
LDC Asia	5.4	10.0	8.2	4.6	4.0
Other LDC	5.4	6.6	9.4	4.7	-0.3
Total LDC	5.4	8.2	8.9	4.6	1.8
Total WOCA	2.8	4.7	4.4	-0.6	0.8
TCE	2.7	4.4	3.7	-1.6	0.1

*Organization for Economic Cooperation and Development.

more than offsetting the reduced but still positive growth in coal usage by the LDCs. In tonnage terms, total WOCA coal usage declined by 0.6 percent in 1982. When adjusted to tonnes of coal equivalent (TCE)*, the decline was 1.6 percent. This greater decline in coal usage, when measured in tonnes of coal equivalent, reflects the severe impact recession had had on the world steel industry and its use of high quality, high heat content metallurgical coal. The performance of the metallurgical coal market relative to the steam coal market will be examined below.

Aided by economic recovery and a warmer summer and colder winter, U.S. coal consumption increased 2.4 percent in 1983. For the rest of WOCA, however, the impact of recession was still being felt in 1983, so that the net increase in total WOCA coal usage was only 0.8 percent.

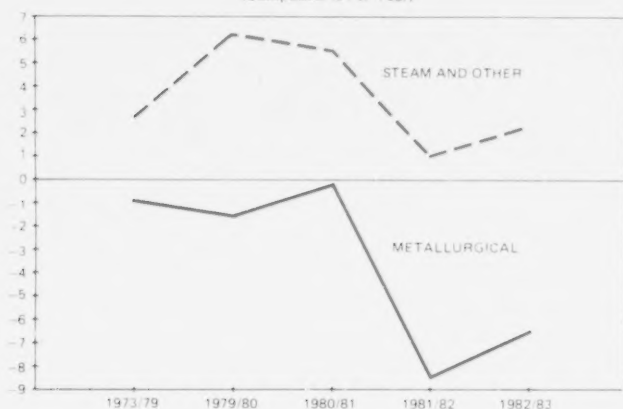
Metallurgical Coal Versus Other Coal Market Sectors

While WOCA's use of all coal grew strongly between 1973 and 1981, before trailing off in 1982 and 1983, not all segments of the market participated in the increase. The two broad market segments are: (1) the metallurgical (coking) coal segment, which represents the use of coal for the production of coke; and (2) the steam and other non-coking application segment, where coal is used for its thermal properties in steam raising or direct heat applications. The majority of the coal in this second category is consumed in the production of electric power. The use of coal for synthetic fuel production (gases and liquids) is included in this second category, since the vast majority of ultimate end use of the product produced is for heat.

* Standardized to 7,000 kilocalories per kilogram (12,700 BTU/lb.)

As shown in Figure 1, despite the impact of recession in 1981-82, the use of coal in steam and other heat applications maintained a positive rate of growth over the past 10 years. In contrast, metallurgical coal consumption declined throughout the period. This disparity in the performance of the two broad market categories of coal reflects the paradox of benefits that coal derived from the dramatic increase in energy prices experienced up through 1981. For the steam coal market segment, higher oil prices led to increased growth because of the increased use at existing coal-fired power plants and the conversion of facilities which used oil and natural gas in the electric utility and industrial sectors. In addition, the increase in the price of oil and, in some instances, natural gas largely eliminated these fuels as viable alternatives in new power plants in nations lacking domestic supplies of these energy forms.

FIGURE 1
GROWTH IN WOCA COAL CONSUMPTION
(Compound % Per Year)



While the steam coal sector was deriving the benefits of higher energy prices, the opposite was occurring in the metallurgical coal sector. In addition to the effects of recession, several other factors contributed to large reduction in steel demand. These include the downsizing and material substitution in automobiles, the miniaturization of home appliances and the substitution of lighter, longer-lasting materials for steel in other applications. All these factors were in direct response to higher energy costs. Finally, structural changes in the makeup of world economies and within the global steel industry itself, both indirectly tied to higher energy prices, were also reducing steel demands.

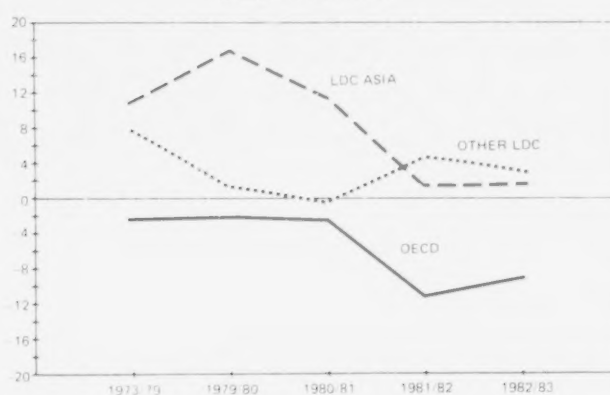
One example of these changes was the de-emphasis of heavy industry in favor of "high tech" industry. For instance, relatively higher labor costs meant that Japan and other developed countries were losing their competitive advantage in the processing of materials and in heavy industrial production. While there certainly was a need to find competitive advantages with new products, even if energy prices had remained constant, the increases in energy prices accelerated this effort. Some spin-offs of this movement to high technology are the improvements in machinery and manufacturing processes which served to reduce steel demand, relative to what it was previously.

Within the steel industry itself, reduced steel demand and greatly reduced profitability forced steel producers, particularly in the developed countries, to focus on their most efficient cost-effective methods of production. For many, this meant the closing of older, less efficient integrated steelmaking operations. The remaining integrated operations, in addition to being more efficient in the use of capital and labor, were also more energy efficient, meaning they required less coke per unit of pig iron produced. In addition to the elimination of less efficient blast furnaces, the steel industry was also accelerating its use of electric furnaces which rely on scrap for feedstock, rather than blast furnace produced molten pig iron.

Other changes in the steel industry affecting coal demands over the past 10 years include: (1) the increased use of continuous casting, which reduces scrap and therefore reduces the quantity of raw steel needed to be produced to satisfy demand and (2) improvements in blast furnace operations, which include the reduction of the silicon content of the iron ores charged in the furnace, increased operating pressures, injection of moisture, etc., all of which reduces coke consumption per unit of iron produced.

The net effect of the changes in the steel markets and the structural changes within the steel industry was the decline in metallurgical coal consumption as illustrated in Figure 1. While metallurgical coal consumption partly benefited by the switch to "oil-less" blast furnace operation (which in certain countries like Japan meant increased coke consumption per unit of pig iron produced), as a direct or indirect result of the rapid increase in the price of oil and other energy products, overall consumption declined over the decade. This decline, however, was entirely centered in the OECD region, as shown in Figure 2. The LDC's were in fact increasing their use of metallurgical coal as integrated steel mills were being constructed in Korea, Taiwan, Brazil and other developing countries. This situation reflected the competitive advantage held by these nations for integrated steel production because of their lower cost of labor and use of the most modern of production technologies when constructing new facilities. The developed countries, in contrast, had to concentrate on improving the operation of existing facilities.

FIGURE 2
GROWTH IN WOCA METALLURGICAL COAL CONSUMPTION
(Compound % Per Year)



Energy Conservation and the Use of Coal for Heat

While the metallurgical coal segment of the market was the most affected, the steam coal segment was not immune to the negative effects of higher energy costs. For instance, even though coal was relatively cheaper to use following the oil price shocks, the cost of using it by the new consumer was still significantly greater in real terms, relative to the cost of energy used prior to the initial oil price increases in 1973-74. Therefore, the drive for conservation through improvements in energy efficiency not only impacted the users of oil but also those consumers who were switching to coal, particularly in the industrial sector. The dampening effects of conservation efforts on coal demand, relative to what would have been if there was a one-for-one substitute of coal energy for oil energy, was most observable in the cement industry.

For example, in 1974, fossil fuel energy consumed by the U.S. cement industry to produce one tonne of clinker ranged from 3.9 million BTU to 13.0 million BTU. In total, the U.S. cement industry consumed 471.8 trillion (10¹²) BTU of fossil fuel energy in the production of 70.8 million tonnes of clinker in 1974. Coal provided 41.1 percent of the total fossil fuel energy consumed in 1974, with natural gas and oil contributing 45.3 percent and 13.6 percent, respectively.

By 1982, because of the price increases and supply difficulties created by regulatory problems with the U.S. natural gas industry and the rapid increases in oil prices, the use of coal by the U.S. cement industry had increased to 87 percent of the industry total fossil fuel energy requirements, with natural gas falling to 9 percent of the total and oil declining to 4 percent. As a result of the industry's shift away from natural gas and oil, coal consumption by the U.S. cement producers increased from 7.3 million tonnes in 1974 to 10.0 million tonnes in 1982, despite the decline in clinker production from 70.8 million tonnes to 54.7 million tonnes over the same period. With fuel costs running 35 percent to 40 percent or more of the total cost of clinker production, however, the U.S. cement producers, like their world brethren, were also implementing changes in their manufacturing processes to improve energy efficiencies simultaneously with the shift to coal as their primary energy source. One such change was the shift from the wet process for cement production to the dry process. In 1982, the fuel requirements in dry process plants averaged 4.8 million BTU per tonne of clinker, while fuel consumption for kiln firing in wet process plants average 6.4 million BTU per tonne of product. In 1982, 53 percent of the U.S. clinker production was produced via the dry process versus 38.7 percent in 1974.

Additional fuel savings were achieved with the addition of preheaters. For instance, in 1982, U.S. cement kilns without preheaters consumed an averaged 6.1 million BTU of fossil energy per tonne of clinker produced. In contrast, those plants with suspension preheaters consumed 4.6 million BTU per tonne, while those with grate-type preheaters averaged 5.5 million BTU per ton of product.

In total, as a result of the energy efficiency improvements outlined above, fossil fuel energy consumption per tonne of clinker produced by the U.S. cement industry averaged 5.5 million BTU in 1982, a decline of 17.9 percent from the average for 1974. Therefore, while the consumption of coal by the U.S. cement industry increased because of the dramatic change in its economic attractiveness vis-a-vis natural gas and oil, conservation effects produced by significantly higher real costs of energy in total dampened the benefits to coal. Had the improvements in energy efficiency outlined above not occurred, the U.S. cement sector would have required approximately 12.0 million tonnes of coal in 1982, rather than the 10.0 million tonnes actually consumed. The cement industries in other areas of the world were already relatively more energy efficient than the U.S. and, therefore, the conservation effects in coal demands were less dramatic. Nevertheless, the effect was still present.

The conservation effects produced by the consumers' response to higher energy prices were not entirely limited to the industrial sector. Indirectly, the higher real costs of electricity, because of higher fuel costs, served to reduce the growth rates in electric demand and production. This effect is illus-

trated in Figure 3, which shows an index of electricity consumption per unit of real GDP (Gross Domestic Product) for the period 1968 through 1982.

As shown in the figure, there was a sharp departure in the rate of growth in electricity consumption per unit of GDP during the period 1973 through 1979, relative to the previous 5 years. The rate of growth, however, was still positive. Following the second oil price shock, the growth in electricity usage per unit of real GDP turned negative in the industrialized nations and was almost cut in half in the LDC segment.

Quite obviously, recession and its impact on heavy industry, such as steel and aluminum production, played a major role in producing the results shown in Figure 3. Nevertheless, what happened to energy prices contributed to recession which, along with energy conservation and the movement to high tech industry, has permanently changed the structure of economies and industries which, in turn, has led to a reduction in the quantity of energy, including electricity, that is required to operate world economies. In addition, consumers, in response to higher electricity prices, increased their purchase of energy efficient appliances such as refrigerators, air conditions, etc., further contributing to an energy price induced decline in the relationship between economic activity and electricity consumption.

Lower growth in electricity demand, coupled with the additions of new nuclear power plants which were planned during a period of higher demand forecasts, also served to dampen the full benefits that coal would have garnered with the rapid acceleration in oil and natural gas prices worldwide. Overall, as in the cement sector, the shift to the emphasis of coal by the electric utility sector outweighed the dampening effects of conservation, resulting in the increased use of coal in the generation of electricity in the vast majority of the consuming regions.

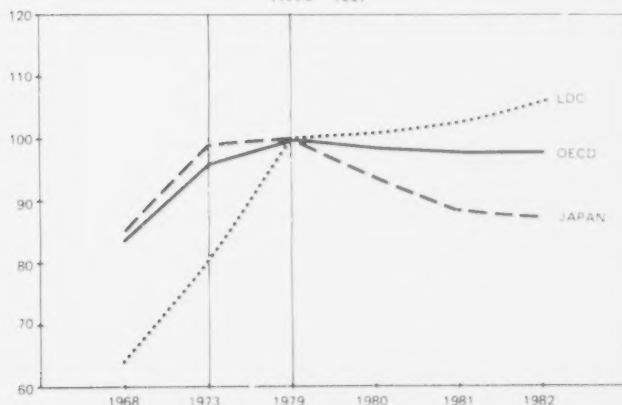
Summary and Conclusion

In summary, over the past ten years, the coal market has been both beneficiary and victim to higher energy costs. Even though the demand for coal accelerated with the rapid increase in the price of oil, energy cost induced recession, technological improvements and structural changes in world economies and industries tempered and, in some instances, offset the initial gains in the market. Nevertheless, led by the steam coal sector, WOCA's use of coal expanded since 1973, in contrast to the overall decline experienced in the 10 years prior to the first oil price shock.

As for the future, growth in the markets for coal will continue to be affected by the energy cost induced changes in the use of energy outlined above. The degree of influence these changes have on the coal market will be decreasing over time as the alteration of industries and economies approach completion. This situation, along with world economic recovery and accompanying increase in electricity demand, steel production, cement manufacturing, etc. will lead to recovery in the markets for coal.

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FIGURE 3
INDEX OF ELECT./UNIT OF REAL GDP
(1979 = 100)





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